

# Human Performance Metrics for Spacesuit Evaluation

Completed Technology Project (2016 - 2019)



## Project Introduction

**Introduction:** Human spaceflight and exploration beyond low-earth orbit requires providing crewmembers life support systems in various extreme environments, such as microgravity, the moon, and Mars, in the form of extravehicular activity (EVA) spacesuits. Critical to mission success is the ability for crewmembers to successfully perform a series of mission-related operational tasks while mitigating risks to health and injury. Therefore, methods for evaluating suited human performance and spacesuit design need to incorporate complex mission related dynamics, such as operationally relevant tasks. Important to suited EVA performance is minimizing the risk to crew health to avoid crewmember overexertion and injury and ensure mission success. The proposed method will develop and validate quantitative metrics for decisions that are currently made qualitatively with regard to a spacesuit design's risk to astronaut health and injury during EVA operations. **Problem Statement:** There are currently no quantitative methods for computing the health and injury risk to suited crewmembers in operationally relevant settings. Understanding the mobility and performance needs of astronauts during EVA aids in mitigating the jeopardy to crew member health. This requires a quantitative toolset for comparing and evaluating current and future human spacesuit performance as a means of designing innovative future spacesuits that mitigate these risks to crewmember health. **Research Plan:** A standardized method for evaluating EVA performance and injury risk provides methodology for innovating and robustness for defining the requirements of future spacesuit systems. Inclusion of user and decision maker needs in the evaluation processes maximizes usability, understanding, and implementation of novel evaluation methods, expediting the design iterations of future systems and the understanding of human spacesuit performance. To this end, the specific aims of this study are as follows: **Aim 1:** Use of cognitive task analysis to determine a series of operationally relevant assessments, tasks, needs for decision makers during the evaluation of human spacesuit performance in the context of defining spacesuit design requirements for minimizing risk to crew health. **Aim 2:** Creation of appropriate new performance metrics and data acquisition modalities to quantify performance during operationally relevant tasks. **Aim 3:** Validation of operationally relevant, quantitative performance metrics with operational decision makers. **Impact:** The proposed framework enables a standardized method to determine an astronaut's risk to health and injury during EVA operations. These metrics can then be used by suit design engineers to make decisions on the appropriate Do Not Harm requirements for current and future spacesuit designs.

## Anticipated Benefits

The proposed framework enables a standardized method to determine an astronaut's risk to health and injury during EVA operations. These metrics can then be used by suit design engineers to make decisions on the appropriate Do Not Harm requirements for current and future spacesuit designs.



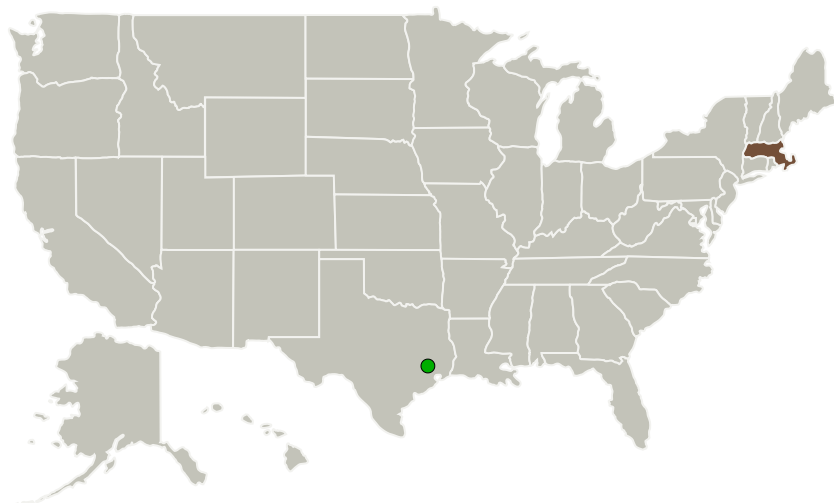
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Massachusetts Institute of Technology(MIT)	Lead Organization	Academia	Cambridge, Massachusetts
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

### Primary U.S. Work Locations

Massachusetts

### Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Massachusetts Institute of Technology (MIT)

### Responsible Program:

Space Technology Research Grants

## Project Management

### Program Director:

Claudia M Meyer

### Program Manager:

Hung D Nguyen

### Principal Investigator:

Leia Stirling

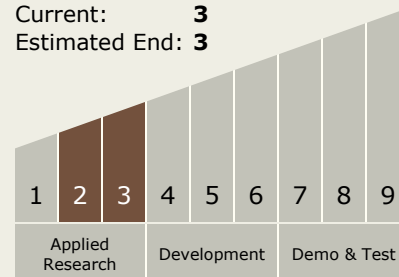
### Co-Investigator:

Richard A Fineman



## Technology Maturity (TRL)

Start: **2**  
Current: **3**  
Estimated End: **3**



## Technology Areas

### Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.6 Human Systems Integration
    - └ TX06.6.1 Human Factors Engineering

## Target Destinations

The Moon, Mars, Earth